CONTROL THEORY IN RHEOLOGY

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This short review presents principles for different polymer melt flows recently introduced and published in the papers[1–5] and introduces ongoing studies. The model starts from the dimensions of statistical tube of a single molecule chain, which conducts to the formula according to Control Theory. The final mathematical formula is the homogeneous differential equation, where RED (Rheological Effective Distribution) is the fingerprint of the behaviors of polymer. This function has similarities with the elugram or elution curve used in chromatography analyses. The RED can be converted and related to the many viscoelastic flow functions as shear and complex viscosity, dynamic moduli, relaxation modulus and spectra, transition viscosity, start-up and elongation viscosity. Further, by melt calibration, which has again similarities with the procedures used with the chromatography analyses, RED is converted to the MWD. Also case studies are presented. The tittles published in the attached reference list describe the progress of the subject.

[1] T. Borg, E. J. Pääkkönen, Linear viscoelastic models: Part I. Relaxation modulus and melt calibration, J. Non-Newtonian Fluid Mech. 156 (2009) 121–128.

[2] T. Borg, E. J. Pääkkönen, Linear viscoelastic models: Part II. Recovery of the molecular weight distribution using viscosity data, J. Non-Newtonian Fluid Mech. 156 (2009) 129–138.

[3] T. Borg, E. J. Pääkkönen, Linear viscoelastic models: Part III. Start-up and transient flow effects from the molecular weight distribution, J. Non-Newtonian Fluid Mech. 159 (2009) 17–25.

[4] T. Borg, E. J. Pääkkönen, Linear viscoelastic models: Part IV. From molecular dynamics to temperature and viscoelastic relations using control theory, J. Non-Newtonian Fluid Mech., 165 (2010) 24–31.

[5] T. Borg, E. J. Pääkkönen, Linear viscoelastic model for elongational viscosity by control theory, Rheologica Acta, (2011) Doi: 10.1007/s00397-011-0598-2.